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(54) **UNIVERSAL FURNACE CONTROLLER AND METHOD OF INSTALLING SAME**

(71) Applicant: **Emerson Electric Co.**, St. Louis, MO (US)

(72) Inventor: **David L. Vie**, Union, MO (US)

(73) Assignee: **Emerson Electric Co.**, St. Louis, MO (US)

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F23N 5/20 (2006.01)
F23N 5/26 (2006.01)
F23Q 7/24 (2006.01)

(52) **U.S. Cl.**

CPC ***F23N 5/242*** (2013.01); ***F23N 5/203*** (2013.01); ***F23N 5/265*** (2013.01); *F23Q 7/24* (2013.01)

(58) **Field of Classification Search**

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USPC 431/18, 71
See application file for complete search history.

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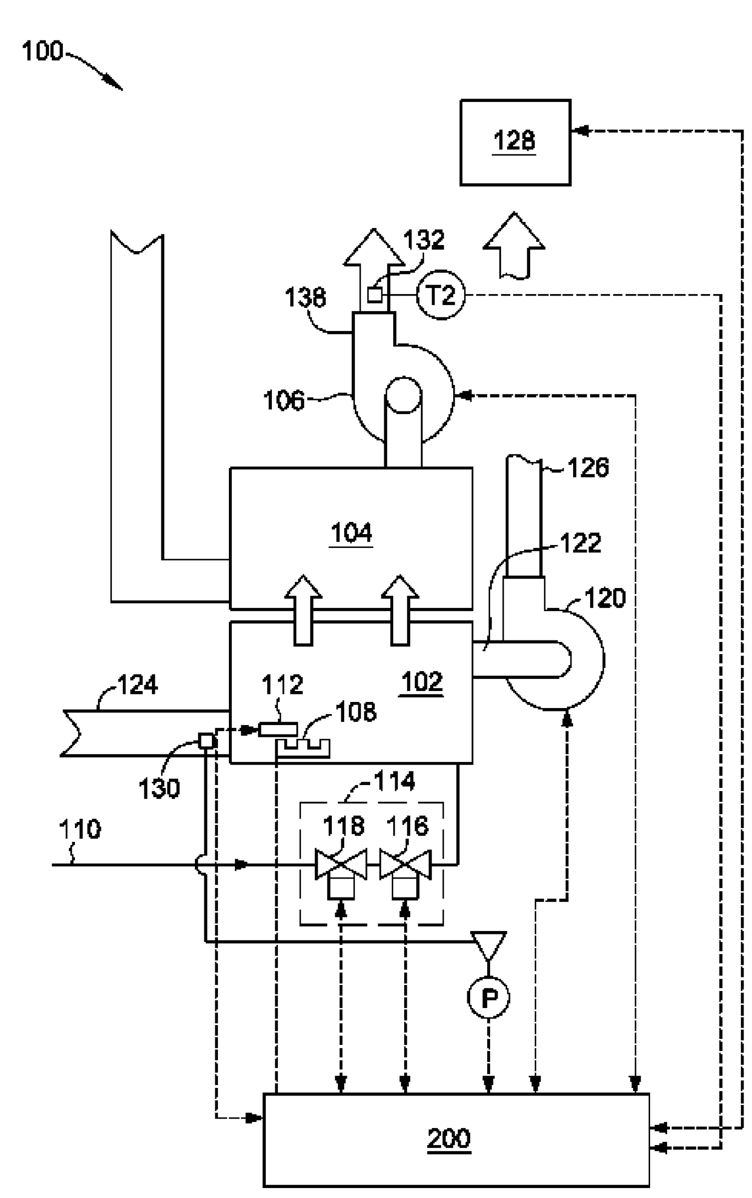
Primary Examiner — Avinash Savani
(74) *Attorney, Agent, or Firm* — Armstrong Teasdale LLP

(57) **ABSTRACT**

A controller for use in a gas furnace system including a gas valve and an ignition device is provided. The controller includes a circuit board, a control circuit connected to the circuit board, and a plurality of harness connectors mounted to the circuit board. The control circuit is configured to control operation of the gas valve and the ignition device. Each harness connector is configured to mate with a wiring harness to electrically connect the control circuit to at least one component of the furnace system. Each harness connector includes a plurality of pin connectors defining a pin configuration of the corresponding harness connector, and each pin configuration is different than the other pin configurations. At least one pin connector from each harness connector is electrically connected in parallel with one of the pin connectors from each of the other harness connectors.

22 Claims, 4 Drawing Sheets



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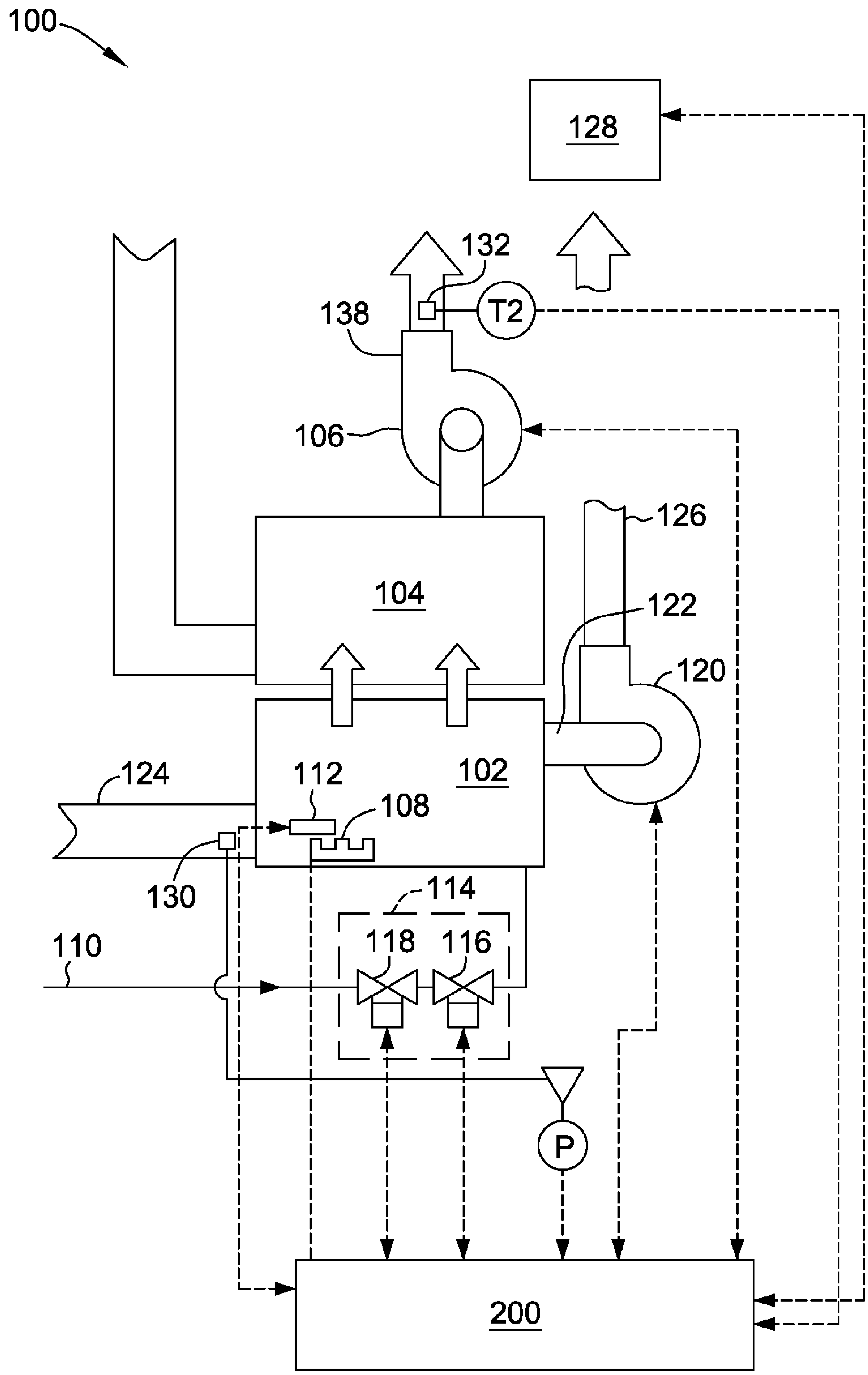
100
128
132
T2
138
106
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102
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112
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130
114
110
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116
P
200

FIG. 1

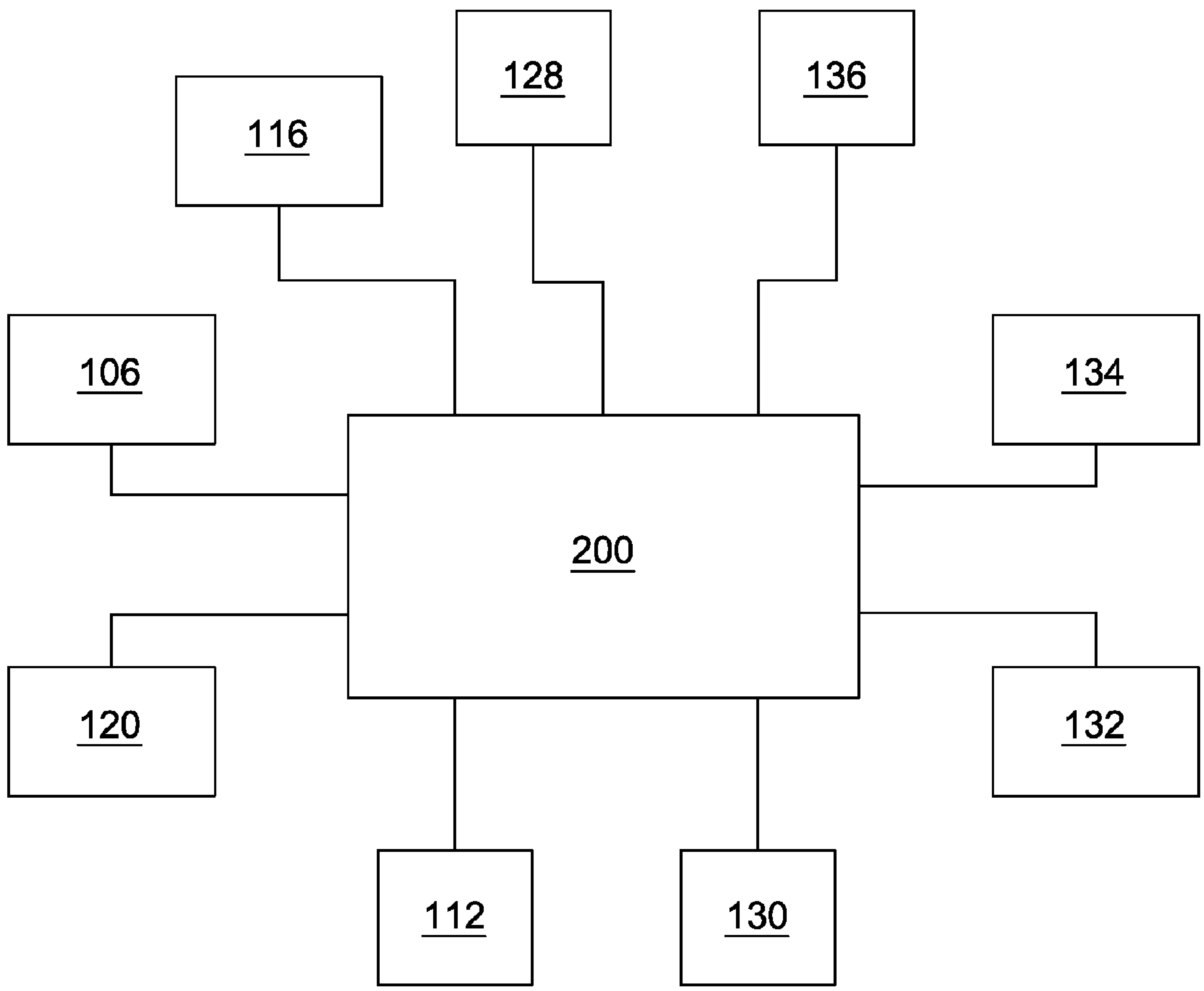
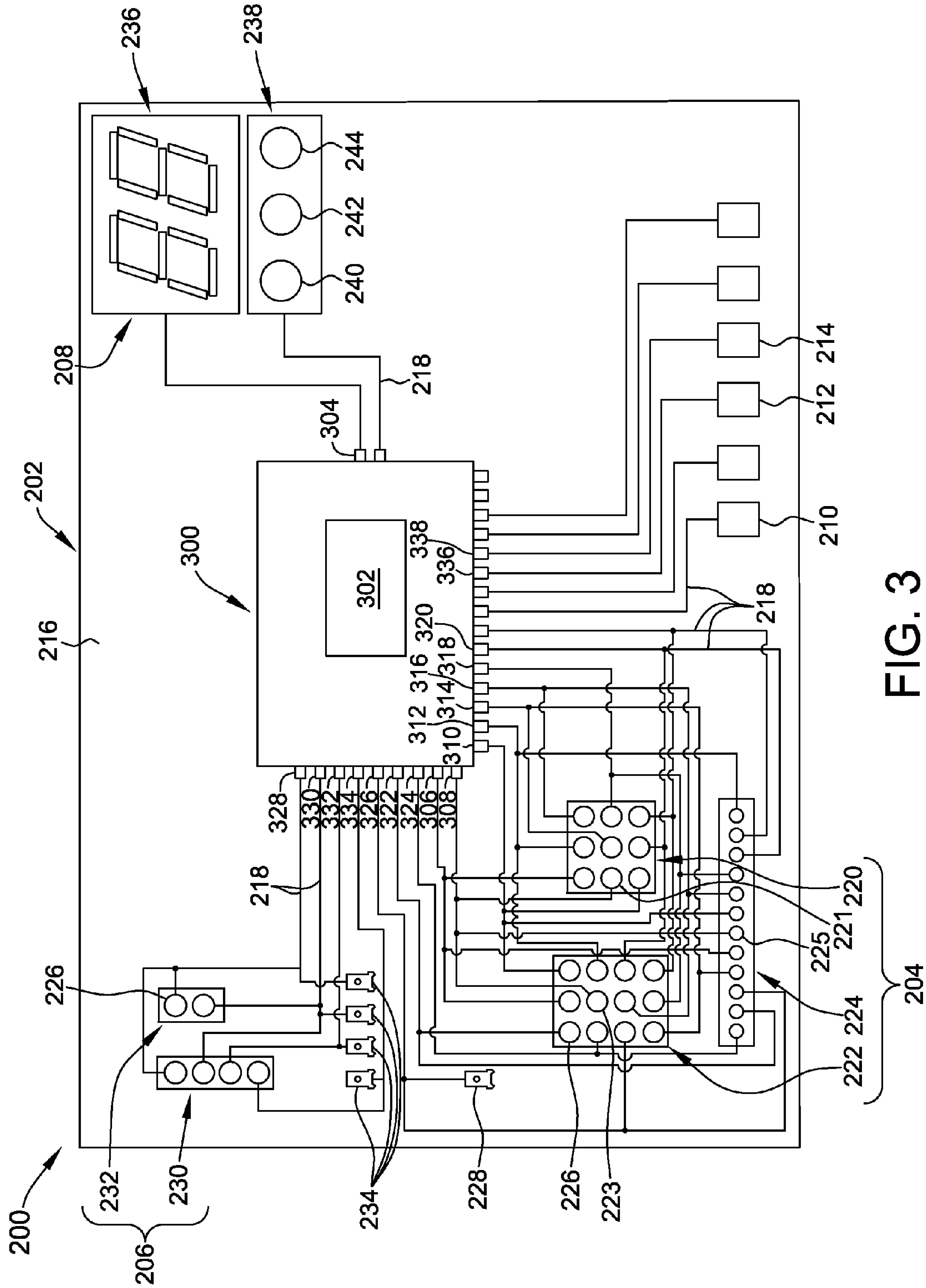


FIG. 2


236
238
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304
202
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210
212
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218
328
330
332
334
326
322
324
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221
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224
204
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234
228
226
223
200
206

FIG. 3

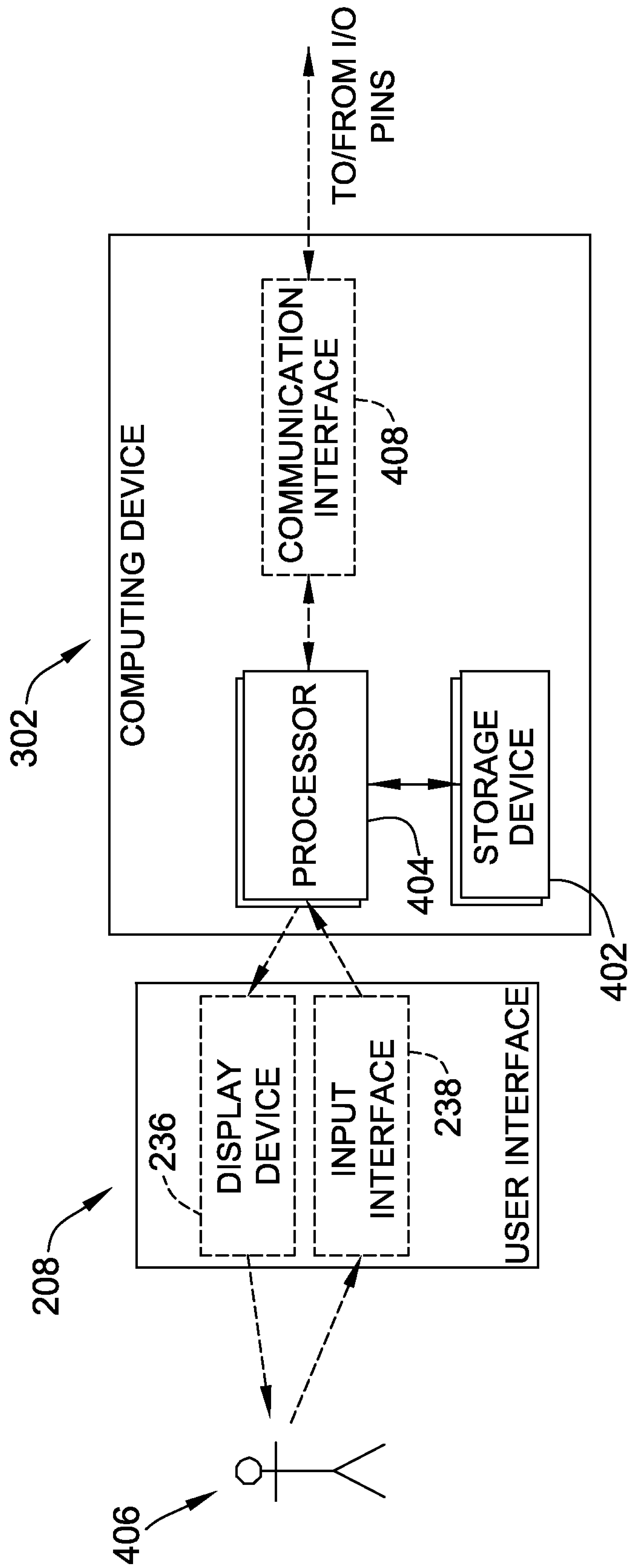
TO/FROM I/O PINS
302
COMPUTING DEVICE
COMMUNICATION INTERFACE
408
PROCESSOR
404
STORAGE DEVICE
402
208
USER INTERFACE
DISPLAY DEVICE
236
INPUT INTERFACE
238
406

FIG. 4

UNIVERSAL FURNACE CONTROLLER AND METHOD OF INSTALLING SAME

FIELD

The field of the disclosure relates generally to gas-powered furnace systems, and more particularly, to furnace controllers for use in gas-powered furnace systems.

BACKGROUND

Gas powered furnace systems generally include a burner, a gas valve for controlling the supply of gas to the burner, and an ignition device to ignite gas supplied to the burner. Heat generated from the burner is circulated through a heat exchanger, and a circulator blower circulates air across the heat exchanger and into a temperature controlled environment to provide heat to the temperature controlled environment. A furnace controller is often used to control various components of the furnace system to ensure proper operation of the furnace system. Some furnace systems include one or more sensors or detectors to monitor the environmental and operating conditions of the furnace system. Information from the sensors and detectors may be relayed to the furnace controller, and the furnace controller may control one or more components based on the information received from the sensors and detectors.

Furnace controllers are often connected to components of the furnace system by wiring harnesses. The use of wiring harnesses facilitates installation of furnace controllers by reducing the number of separate electrical connections needed to connect a furnace controller to a furnace system. However, different furnace systems often have wiring harnesses with different pin configurations. For example, wiring harnesses may have a different geometrical arrangement of pins, a different number of pins, and/or a different electrical arrangement of pins based on the manufacturer of the furnace system. As a result, furnace controllers are generally not compatible with multiple types of furnace systems, such as furnace systems manufactured by different furnace system manufacturers.

Attempts to improve the compatibility of furnace controllers have included providing furnace controllers with a plurality wiring harness adapters or interconnecting devices, which are used to interconnect a furnace controller with the wiring harness of a furnace system. The wiring harness adapters and interconnecting devices often have different pin configurations to enable the furnace controller to be connected to wiring harnesses having different pin configurations.

However, the use of wiring harness adapters and interconnecting devices has several drawbacks. For example, often only one harness adapter or interconnecting device is used to connect a furnace controller to a furnace system. Thus, other harness adapters and interconnecting devices provided with the furnace controller are not used, resulting in excess costs and waste. Additionally, the use of harness adapters and interconnecting devices increases the complexity of installing a furnace controller because it requires additional electrical connections between the furnace system and the furnace controller, and requires proper identification of the harness adapter or interconnecting device needed to connect the furnace controller to a particular furnace system. Accordingly, a need exists for a more satisfactory furnace controller.

This Background section is intended to introduce the reader to various aspects of art that may be related to various aspects of the present disclosure, which are described and/or claimed below. This discussion is believed to be helpful in providing the reader with background information to facilitate a better understanding of the various aspects of the present disclosure. Accordingly, it should be understood that these statements are to be read in this light, and not as admissions of prior art.

SUMMARY

In one aspect, a controller for use in a gas furnace system including a gas valve and an ignition device is provided. The controller includes a circuit board, a control circuit connected to the circuit board, and a plurality of harness connectors mounted to the circuit board. The control circuit is configured to control operation of the gas valve and the ignition device. Each harness connector is configured to mate with a wiring harness to electrically connect the control circuit to at least one component of the furnace system. Each harness connector includes a plurality of pin connectors defining a pin configuration of the corresponding harness connector, and each pin configuration is different than the other pin configurations. At least one pin connector from each harness connector is electrically connected in parallel with one of the pin connectors from each of the other harness connectors.

In another aspect, a furnace system is provided. The furnace system includes a burner, a gas valve for controlling the supply of gas to the burner, an ignition device for igniting gas supplied to the burner assembly, and a controller. The controller includes a circuit board, a control circuit connected to the circuit board, and a plurality of harness connectors mounted to the circuit board. The control circuit is configured to control operation of the gas valve and the ignition device. Each harness connector includes a plurality of pin connectors, and at least one pin connector from each harness connector is electrically connected in parallel with one of the pin connectors from each of the other harness connectors. Only one of the harness connectors is connected to the furnace system by a wiring harness.

In yet another aspect, a method of installing a furnace controller in a furnace system including a gas valve, an ignition device, and a wiring harness is provided. The furnace controller includes a circuit board, a control circuit configured to control operation of the gas valve and the ignition device, and a plurality of harness connectors mounted to the circuit board. Each harness connector includes a plurality of pin connectors, and at least one pin connector from each harness connector is electrically connected in parallel with one of the pin connectors from each of the other harness connectors. The method includes mounting the controller to the furnace system, selecting one of the harness connectors for connection to the wiring harness of the furnace system based on a pin configuration of the wiring harness, and connecting only the selected harness connector to the wiring harness to electrically connect the control circuit to at least one component of the furnace system.

Various refinements exist of the features noted in relation to the above-mentioned aspects. Further features may also be incorporated in the above-mentioned aspects as well. These refinements and additional features may exist individually or in any combination. For instance, various features discussed below in relation to any of the illustrated

embodiments may be incorporated into any of the above-described aspects, alone or in any combination.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic diagram of a gas furnace system including a furnace controller.

FIG. **2** is a block diagram illustrating the furnace controller of FIG. **1** and the component connections of the gas furnace system of FIG. **1**.

FIG. **3** is a schematic diagram of the furnace controller of FIG. **1** including a computing device and a user interface.

FIG. **4** is a block diagram of the computing device and the user interface of FIG. **3**.

DETAILED DESCRIPTION

Referring to FIG. **1**, a gas furnace system of one embodiment for heating a temperature controlled environment is indicated generally at **100**. The gas furnace system **100** generally includes a combustion chamber **102** for generating heat from combustible gases, a heat exchanger **104**, and an air circulator **106** for circulating fluid (e.g., air) past the heat exchanger **104** to transfer heat generated by the combustion chamber **102** to the circulating fluid.

The combustion chamber **102** includes a burner assembly **108** connected to a gas fuel supply (not shown) via a gas inlet **110**, and an ignition device **112**, such as a hot surface ignitor, configured to ignite an air/fuel mixture within the combustion chamber **102**. The burner assembly **108** includes one or more burners through which fuel gas is fed. The supply of fuel gas to the burner assembly **108** is controlled by a gas valve assembly **114**, which, in the illustrated embodiment, includes a main burner valve **116** and a safety valve **118**.

An inducer blower **120** is connected to the combustion chamber **102** by a blower inlet **122**. The inducer blower **120** is configured to draw fresh (i.e., uncombusted) air into the combustion chamber **102** through an air inlet **124** to mix fuel gas with air to provide a combustible air/fuel mixture. The inducer blower **120** is also configured to force exhaust gases out of the combustion chamber **102** and vent the exhaust gases to atmosphere through an exhaust outlet **126**.

The combustion chamber **102** is fluidly connected to the heat exchanger **104**. Combusted gases from the combustion chamber **102** are circulated through the heat exchanger **104** while the air circulator **106** forces air from the temperature controlled environment into contact with the heat exchanger **104** to exchange heat between the heat exchanger **104** and the temperature controlled environment. The air circulator **106** subsequently forces the air through an outlet **138** and back into the temperature controlled environment.

The operation of the system **100** is generally controlled by a furnace controller **200** and a thermostat **128** connected to the furnace controller **200**. The thermostat **128** is connected to one or more temperature sensors (not shown) for measuring the temperature of the temperature controlled environment. The furnace controller **200** is connected to each of the gas valve assembly **114**, the ignition device **112**, the inducer blower **120**, and the air circulator **106** for controlling operation of the components in response to control signals received from the thermostat **128**.

With additional reference to FIG. **2**, the system **100** includes a plurality of sensors and detectors for monitoring the environmental and operating conditions of the system **100**. The illustrated furnace system includes a pressure sensor **130**, a temperature sensor **132**, a flame rollout detector **134**, and a flame sensor **136**. The controller **200** is connected to each of the pressure sensor **130**, the temperature sensor **132**, the flame rollout detector **134**, and the flame sensor **136**, and is configured to control the furnace system **100** based on signals received from the sensors and detectors.

The pressure sensor **130** is configured to provide a pressure indication to the controller **200** indicative of the pressure within the combustion chamber **102**. In the example embodiment, the pressure sensor **130** includes an open/close switch that is opened when a detected pressure is below a threshold pressure limit and closed when a detected pressure is above the threshold pressure limit. In other suitable embodiments, the pressure sensor **130** includes an analog and/or digital sensor configured to output an analog and/or digital signal indicative of an actual or relative pressure to the controller **200**. In the illustrated embodiment, the pressure sensor **130** is positioned proximate the air inlet **124**, and is configured to detect the pressure of fresh air being supplied to the combustion chamber **102**. In other suitable embodiments, the pressure sensor **130** may be positioned at any suitable location within the furnace system **100** that allows the furnace system to function as described herein including, for example and without limitation, within the combustion chamber **102** and within the blower inlet **122**.

The temperature sensor **132** is configured to provide a temperature indication to the controller **200** indicative of a temperature T2 within the furnace system **100**. In the example embodiment, the temperature sensor **132** includes an open/close switch that is opened when a detected temperature is above a threshold temperature limit and closed when a detected temperature is below the threshold pressure limit. In other suitable embodiments, the temperature sensor **132** includes an analog and/or digital sensor configured to output an analog and/or digital signal indicative of an actual or relative temperature to the controller **200**. In the illustrated embodiment, the temperature sensor **132** is positioned proximate the heat exchanger **104**, and is configured to detect a high temperature condition within the heat exchanger **104**. That is, the temperature sensor **132** is configured to communicate with controller **200** to indicate the presence of a high temperature condition (e.g., a detected temperature above a threshold temperature limit) within the heat exchanger **104**.

The flame rollout detector **134** is configured to detect a flame rollout condition within the furnace system **100**, and communicate with the controller **200** to indicate that a flame rollout condition has been detected. The term "flame rollout condition" refers to a condition in which the combustion of the air/fuel mixture occurs outside of the normal combustion area within the combustion chamber **102**. For example, if the exhaust outlet **126** is impeded during operation, flames that are normally confined to an area immediately adjacent the burner assembly **108** may spread to other areas of the furnace system **100**, such as outside the combustion chamber **102**, creating a risk of damaging components of the furnace system **100**. Flame rollout detector **134** is configured to detect a flame rollout condition to prevent abnormal operation of furnace system **100** and potential damage to components of the furnace system **100**. The flame rollout detector **134** may include any suitable detectors and/or sensors that enable the flame rollout detector **134** to function as described herein including, for example and without limitation, temperature sensors, pressure sensors, and optical detectors. In the example embodiment, the flame rollout detector **134** includes an open/close switch that is opened when a flame rollout condition is detected, and closed when the flame rollout condition is no longer detected. In other suitable embodiments, the open/close switch may only be closed following the detection of a flame rollout condition with human intervention (e.g., by resetting the controller **200**).

The flame sensor **136** is configured to detect the presence of a flame at the burner assembly **108**, and communicate with the controller **200** to indicate the presence or absence of a flame. The flame sensor **136** may include any suitable sensor and/or detector for detecting the presence of a flame including, for example and without limitation, thermo-electric devices (e.g., thermopiles), and optical flame detectors.

Components of the furnace system **100**, such as the main burner valve **116**, the ignition device **112**, the inducer blower **120**, the pressure sensor **130**, the temperature sensor **132**, the flame rollout detector **134**, and the flame sensor **136**, may be electrically connected to the controller **200** by one or more wiring harnesses. In one suitable embodiment, for example, the main burner valve **116**, the pressure sensor **130**, the temperature sensor **132**, the flame rollout detector **134**, and the flame sensor **136** are each electrically connected to the controller **200** by a primary or main wiring harness, and the ignition device **112** and the inducer blower **120** are each electrically connected to the controller **200** by a secondary wiring harness. A wiring harness is an assembly of cables or wires bound or secured together by suitable means including, for example and without limitation, straps, cable ties, cable lacing, sleeves, electrical tape, conduit, and combinations thereof. The wiring harnesses used to connect components of the furnace system **100** to the controller **200** may include a harness connector adapted to mate with a complementary harness connector mounted on the controller **200**, described in more detail below. In one suitable embodiment, for example, a wiring harness of the furnace system **100** includes a male harness connector adapted to mate with a female harness connector mounted on the controller **200**.

In operation, the thermostat **128** transmits a call for heat to the controller **200** (e.g., in the form of an electrical signal) when a detected temperature within the temperature controlled environment falls below a pre-determined temperature limit. Upon receiving a call for heat, the controller **200** checks the environmental and operating conditions of the furnace system **100** using one or more of the pressure sensor **130**, the temperature sensor **132**, the flame rollout detector **134**, and the flame sensor **136** to ensure the temperature, pressure, and/or other conditions of the furnace system **100** are within predetermined limits. In the example embodiment, the controller **200** outputs a signal to each of the temperature sensor **132** and the flame rollout detector **134** to confirm that the open/close switch of each of the sensors is in the closed position.

Once the environmental and/or operational conditions check is completed, the controller **200** transmits a signal to the inducer blower **120** to energize the inducer blower **120**. The controller **200** may check the pressure within the furnace system **100** using the pressure sensor **130** to ensure an adequate supply of fresh (i.e., uncombusted) air is being supplied into the combustion chamber **102**. In the example embodiment, the controller **200** outputs a signal to the pressure sensor **130** to confirm that the open/close switch of the pressure sensor **130** is in the closed position.

The controller **200** then outputs a signal to the main burner valve **116** to open the main burner valve **116** and enable the supply of fuel gas to the burner assembly **108**. Before, during, or after opening the main burner valve **116**, the controller **200** outputs a signal to the ignition device **112** to energize the ignition device **112** and ignite the air/fuel mixture within the combustion chamber **102**. Where the ignitor is a hot surface ignitor, such as in the example embodiment, the controller **200** may energize the ignition device **112** prior to energizing the main burner valve **116** to allow the ignition device **112** sufficient time to heat up to a temperature sufficient to initiate combustion.

The controller **200** may then check whether flame initiation was successful via the flame sensor **136**. For example, the flame sensor **136** may output a signal to the controller **200** indicating the presence of a flame in the combustion chamber **102**. If no flame is detected by flame sensor **136**, the controller **200** may de-energize one or more of the main burner valve **116**, the ignition device **112**, and the inducer blower **120**, and reattempt to initiate combustion within the combustion chamber **102**. If the flame sensor **136** detects the presence of a flame, the controller **200** energizes the air circulator **106** to circulate air across the heat exchanger **104** and into the temperature controlled environment via outlet **138**.

When the call for heat has been satisfied (i.e., when the detected temperature in the temperature controlled environment is equal to or greater than a pre-determined temperature limit), the thermostat **128** outputs a signal to the controller **200** to indicate the call for heat has been satisfied. The controller **200** then de-energizes the main burner valve **116**, the inducer blower **120**, the ignition device **112**, and the air circulator **106**. The controller **200** may maintain the inducer blower **120** and/or the air circulator **106** in an energized state for a preset delay period after receiving the signal to terminate the heat cycle.

With additional reference to FIG. **3**, the controller **200** includes a printed circuit board **202**, a plurality of main harness connectors **204**, a plurality of secondary harness connectors **206**, a user interface **208**, and a control circuit **300**. The illustrated controller **200** also includes a plurality of input and output connectors, including a power supply input connector **210**, a circulator output connector **212**, and a circulator return connector **214**. The controller **200** may include additional input or output connectors configured to be connected to other components of the furnace system **100** (e.g., the thermostat) for outputting and/or receiving signals from other components of the furnace system **100**. The controller **200** may also include a mounting tray (not shown) fabricated from plastic and a plurality of breakaway mounting tabs (not shown) to facilitate positioning and mounting the controller **200** within the furnace system **100**.

The printed circuit board **202** includes a dielectric substrate **216** and a plurality of conductive interconnects **218** providing a network of electrical connections between the components coupled to the printed circuit board **202**.

The control circuit **300** is configured to control operation of the components of the furnace system **100** by receiving and processing signals from components of the furnace system **100**, and by outputting signals to the components of the furnace system **100** based on the received signals. The control circuit **300** may also be configured to control the supply of power to various components of the furnace system **100**, for example, by activating switches to open or close a power circuit or by outputting control signals to components of the furnace system **100** to energize such components.

In the illustrated embodiment, the control circuit **300** includes a computing device **302** and a plurality of I/O pins **304** configured to provide electrical communication between the computing device **302** and components of the furnace system **100**. The control circuit **300** may also include one or more signal processing circuits (e.g., filter circuits) electrically connected between one of the I/O pins **304** and the computing device **302**.

Each I/O pin **304** is adapted for communication with a corresponding target component of the furnace system **100**. That is, the computing device **302** is configured (e.g., programmed) to receive and process signals from specific target components of the furnace system **100** at specific I/O pins, and to output signals to specific target components of the furnace system **100** from specific I/O pins. For example, the computing device **302** may be configured to output an energizing signal to the main burner valve **116** (i.e., a first target component) from a first I/O pin based on an input signal received at a second I/O pin from the temperature sensor **132** (i.e., a second target component). Target components may include, for example and without limitation, the pressure sensor **130**, the temperature sensor **132**, the main burner valve **116**, the flame rollout detector **134**, the ignition device **112**, the inducer blower **120**, the air circulator **106**, and the thermostat **128** (FIGS. **1** and **2**). Target components may also include components of the controller **200** including, for example and without limitation, power switches.

In the illustrated embodiment, the plurality of I/O pins **304** includes a pressure sensor output pin **306**, a pressure sensor input pin **308**, a temperature sensor output pin **310**, a temperature sensor input pin **312**, a power input pin **314**, a neutral or ground pin **316**, a burner valve output pin **318**, a burner valve return or common pin **320**, a flame rollout detector output pin **322**, a flame rollout detector input pin **324**, a flame sensor I/O pin **326**, an ignition device output pin **328**, an ignition device return or common pin **330**, an inducer blower output pin **332**, an inducer blower return or common pin **334**, an air circulator output pin **336**, and an air circulator return or common pin **338**. The plurality of I/O pins **304** may also include one or more thermostat I/O pins configured for electrical communication with the thermostat **128**.

The power input pin **314** and the neutral pin **316** are adapted for connection to a positive or high terminal and a negative or common terminal, respectively, of a power supply (e.g., 24 VAC) to power the controller **200**.

The control circuit **300** is configured to output a signal to the temperature sensor **132** via the temperature sensor output pin **310**, and receive a signal from the temperature sensor **132** via the temperature sensor input pin **312** to ensure the temperature of the furnace system **100** is within predetermined limits. In the example embodiment, the control circuit **300** outputs a signal to the temperature sensor **132** via the temperature sensor output pin **310** to confirm that the open/close switch of the temperature sensor **132** is closed.

The control circuit **300** is also configured to output a signal to the flame rollout detector **134** via the flame rollout detector output pin **322**, and receive a signal from the flame rollout detector **134** at the flame rollout detector input pin **324** to ensure a flame rollout condition is not present within the furnace system **100**. In the example embodiment, the control circuit **300** outputs a signal to the flame rollout detector **134** via the flame rollout detector output pin **322** to confirm that the open/close switch of the flame rollout detector **134** is closed.

The control circuit **300** is configured to energize the inducer blower **120** via the inducer blower output pin **332** and the inducer blower common pin **334**. In one suitable embodiment, for example, the control circuit **300** closes a switch between the inducer blower output pin **332** and the inducer blower common pin **334** to form a closed power circuit to provide power to the inducer blower **120**.

The control circuit **300** is configured to output a signal to the pressure sensor **130** via the pressure sensor output pin **306**, and receive a signal from the pressure sensor **130** via the pressure sensor input pin **308** to ensure that an adequate supply of fresh (i.e., uncombusted) air is being supplied to the furnace system **100** by the inducer blower **120**. In the example embodiment, the control circuit **300** outputs a signal to the pressure sensor **130** via the pressure sensor output pin **306** to confirm that the open/close switch of the pressure sensor **130** is closed.

The control circuit **300** is configured to energize the main burner valve **116** via the burner valve output pin **318** and the burner valve return pin **320**. In one embodiment, for example, the control circuit **300** closes a switch between the burner valve output pin **318** and the burner valve return pin **320** to form a closed power circuit to energize the main burner valve **116** and maintain the main burner valve **116** in an open position.

The control circuit **300** is configured to energize the ignition device **112** via the ignition device output pin **328** and the ignition device return pin **330**. In one embodiment, for example, the control circuit **300** closes a switch between the ignition device output pin **328** and the ignition device return pin **330** to form a closed power circuit to energize the ignition device **112** and ignite the air/fuel mixture within the combustion chamber **102**. As described in more detail herein, the output voltage supplied to the ignition device **112** via the ignition device output pin **328** and the ignition device return pin **330** may be selectively configurable between a plurality of ignition device output voltages.

The control circuit **300** is configured to receive a signal from the flame sensor **136** via the flame sensor I/O pin **326** to determine whether a flame is present in the furnace system **100**.

The control circuit **300** is configured to energize the air circulator **106** via the air circulator output pin **336** and the air circulator return pin **338**. In one suitable embodiment, for example, the air circulator **106** is connected to a power supply, and the control circuit **300** is configured to output a circulator control voltage to the air circulator **106** to activate the power supply and energize the air circulator **106**.

The main harness connectors **204** are configured to provide an electrical connection between the control circuit **300** and components of the furnace system **100** to enable the control circuit **300** to function as described herein. More specifically, each of the main harness connectors **204** is electrically connected to the control circuit **300** via the conductive interconnects **218**. Each of the main harness connectors **204** is configured to mate with a wiring harness of a furnace system to provide an electrical connection between the control circuit **300** and components of the furnace system. In the illustrated embodiment, the plurality of main harness connectors **204** includes a first main harness connector **220**, a second main harness connector **222**, and a third main harness connector **224**. Although the illustrated controller **200** includes three main harness connectors **204**, the controller **200** may include more than or less than three main harness connectors **204**.

Each of the main harness connectors **204** includes a plurality of pin connectors **226**. Each pin connector **226** is adapted to receive one of a plurality pins from a corresponding wiring harness to provide an electrical connection between the control circuit **300** and one of the components of the furnace system **100**. In the illustrated embodiment, each pin connector **226** has a generally circular shape, although it is understood that the pin connectors may have any suitable shape that enables the controller **200** to function as described herein.

Each of the plurality of pin connectors **226** defines a pin configuration of the corresponding main harness connector **204**. The term "pin configuration" as used with respect to the main harness connectors **204** refers to the number, geometrical arrangement, and electrical arrangement of the pin connectors **226**. As seen in FIG. **3**, each of the main harness connectors **204** has a different pin configuration than the other main harness connectors **204**. More specifically, the first main harness connector **220** includes nine pin connectors **226** generally arranged in square configuration, the second main harness connector **222** includes twelve pin connectors **226** generally arranged in a rectangular configuration, and the third main harness connector **224** includes twelve pin connectors **226** arranged in a linear or "in-line" configuration.

Each of the main harness connectors **204** is configured to mate with a wiring harness having a pin configuration complementary to the pin configuration of the respective main harness connector **204**. Thus, in the illustrated embodiment, each main harness connector **204** is configured to mate with a different type of wiring harness (i.e., wiring harnesses having different pin configurations). More specifically, each main harness connector **204** has a pin configuration that corresponds to one of a plurality of industry standard wiring harnesses such that the controller **200** can be installed in (i.e., electrically connected to) furnace systems manufactured by different furnace system manufactures using one of the main harness connectors **204** without an interface or adapter harness.

Each pin connector **226** is electrically connected to the control circuit **300** via one of the interconnects **218**. As shown in FIG. **3**, at least one pin connector **226** from each main harness connector **204** is electrically connected in parallel with one of the pin connectors **226** from each of the other main harness connectors **204**. In the illustrated embodiment, each pin connector **226** from the first main harness connector **220** is electrically connected in parallel with one pin connector **226** from each of the second main harness connector **222** and the third main harness connector **224**. Further, each pin connector **226** from the second main harness connector **222** is connected in parallel with one pin connector **226** from the third main harness connector **224**.

Pin connectors **226** from different main harness connectors **204** that are connected in parallel with one another are also connected to a common I/O pin **304** on the control circuit **300**. For example, in the illustrated embodiment, one pin connector **226** from each of the main harness connectors **204** is connected to the temperature sensor output pin **310** and is connected in parallel with the other pin connectors **226** connected to the temperature sensor output pin **310**.

Each pin connector **226** is adapted for electrical connection to a target component of the furnace system **100** based upon the I/O pin **304** to which the pin connector **226** is connected. Further, each pin connector **226** is adapted to output and/or or receive a signal from a target component based upon the I/O pin **304** to which the pin connector **226** is connected. For example, each pin connector **226** connected to the temperature sensor output pin **310** is adapted for electrical connection to the temperature sensor **132**, and is adapted to output a signal to the temperature sensor **132**. Each pin connector **226** connected to the temperature sensor input pin **312** is adapted for electrical connection to the temperature sensor **132**, and is adapted to receive a signal from the temperature sensor **132**.

In the illustrated embodiment, each of the main harness connectors **204** is configured to provide an electrical connection between the control circuit **300** and the pressure sensor **130**, the temperature sensor **132**, and the main burner valve **116**. Further, in the illustrated embodiment, the second main harness connector **222** and the third main harness connector **224** are configured to provide an electrical connection between the control circuit **300** and the flame rollout detector **134** and the flame sensor **136**.

One or more of the pin connectors **226** from each of the main harness connectors **204** may be "remapped" by modifying the I/O pin configuration of the control circuit **300**. More specifically, the control circuit **300** is selectively configurable between a plurality of I/O pin configurations in which the control circuit **300** processes signals differently or outputs signals differently from the same I/O pin in different I/O pin configurations. For example, in a first I/O pin configuration, such as the I/O pin configuration illustrated in FIG. **3**, the control circuit **300** is configured to receive an input signal from the pressure sensor **130** at the I/O pin designated **308**. The control circuit **300** (in particular, the computing device **302**) may be configured to process this signal and output one or more signals to one or more other components of the furnace system **100** based on the signal received at the I/O pin **308**. Thus, in the first I/O pin configuration, each pin connector **226** connected to the I/O pin **308** is adapted for connection to the pressure sensor **130**, and is adapted to receive an input signal from the pressure sensor **130**. In the illustrated embodiment, one pin connector from each of the main harness connectors **204**, indicated at **221**, **223**, and **225**, is connected to I/O pin **308**. Thus, in the first I/O pin configuration, each of the pin connectors **221**, **223**, and **225** is adapted for connection to the pressure sensor **130**, and is adapted to receive an input signal from the pressure sensor **130**.

In a second I/O pin configuration, each of the pin connectors **221**, **223**, and **225** connected to I/O pin **308** may be adapted for connection to a different component of the furnace system **100**, and/or may be adapted to output or receive a signal from the input signal from the pressure sensor **130**. For example, in a second I/O pin configuration, the control circuit **300** is configured to receive an input signal from the temperature sensor **132** at the I/O pin designated **308**, and is configured to process the input signal and output one or more signals to one or more other components of the furnace system **100** based on the input signal received at the I/O pin **308**. Additionally, in the second I/O pin configuration, the control circuit **300** is configured to receive an input signal from the pressure sensor **130** at the I/O pin designated **312**, and is configured to process the input signal and output one or more signals to one or more other components of the furnace system **100** based on the input signal received at the I/O pin **312**. Thus, in the second I/O pin configuration, each of the pin connectors **221**, **223**, and **225** is adapted for connection to the temperature sensor **132**, and is adapted to receive an input signal from the temperature sensor **132**. Further, in the second I/O pin configuration, each pin connector **226** connected to the I/O pin designated **312** is adapted for connection to the pressure sensor **130**, and is adapted to receive in input signal from the pressure sensor **130**. By providing main harness connectors **204** with different pin configurations on a single controller, and enabling the pin connectors **226** of the main harness connectors **204** to be remapped, the controller **200** can be electrically connected to furnace systems having different types of main wiring harnesses without using an interface or adapter harness connector. The controller **200** of the present disclosure thereby provides improved compatibility with furnace systems having different types of wiring harnesses, and facilitates reducing the part-count and cost of furnace controllers.

The illustrated controller **200** also includes a flame sensor input connector **228** separate from each of the main harness connectors **204**. The controller **200** is therefore compatible with a furnace system having a flame sensor connecting cable separate from the main wiring harness. The flame sensor input connector **228** is connected to the flame sensor I/O pin **326**, and is connected in parallel with each of the pin connectors **226** from the main harness connectors **204** that are connected to the flame sensor I/O pin **326**.

The secondary harness connectors **206** are configured to provide an electrical connection between the control circuit **300** and components of the furnace system **100** that are not connected to the control circuit **300** by one of the main harness connectors **204**. Each of the secondary harness connectors **206** is electrically connected to the control circuit **300** via the conductive interconnects **218**. Each secondary harness connector **206** is configured to mate with a wiring harness of a furnace system to provide an electrical connection between the control circuit **300** and components of the furnace system. In particular, each secondary harness connector **206** is configured to mate with a secondary wiring harness of a furnace system to provide an electrical connection between the control circuit **300** and at least one of an ignition device and an induced blower of the furnace system. In the illustrated embodiment, the plurality of secondary harness connectors **206** includes a first secondary harness connector **230** and a second secondary harness connector **232**. Although the illustrated controller **200** includes two secondary harness connectors **206**, the controller **200** may include more than or less than two secondary harness connectors **206**.

Each of the secondary harness connectors **206** includes a plurality of the pin connectors **226**. Each pin connector **226** of the secondary harness connectors **206** is adapted to receive one of a plurality pins from a corresponding wiring harness to provide an electrical connection between the control circuit **300** and one of the components of the furnace system **100**. In the illustrated embodiment, each pin connector **226** has a generally circular shape, although it is understood that the pin connectors may have any suitable shape that enables the controller **200** to function as described herein.

Each of the plurality of pin connectors **226** of the secondary harness connectors **206** defines a pin configuration of the corresponding secondary harness connector **206**. The term “pin configuration” as used with respect to the secondary harness connectors **206** refers to the number, geometrical arrangement, and electrical arrangement of the pin connectors **226**. As seen in FIG. **3**, each of the secondary harness connectors **206** has a different pin configuration than the other secondary harness connector **206**. More specifically, the first secondary harness connector **230** includes four pin connectors **226** arranged in a linear or “in-line” configuration, and the second secondary harness connector **232** includes two pin connectors **226** arranged in a linear or “in-line” configuration.

Each secondary harness connector **206** is configured to mate with a wiring harness having a pin configuration complementary to the pin configuration of the respective secondary harness connector **206**. Thus, in the illustrated embodiment, each secondary harness connector **206** is configured to mate with a different type of wiring harness (i.e., wiring harnesses having different pin configurations). More specifically, each secondary harness connector **206** has a pin configuration that corresponds to one of a plurality of industry standard wiring harnesses such that the controller **200** can be installed in (i.e., electrically connected to) furnace systems manufactured by different furnace system manufactures using one of the secondary harness connectors **206** without an interface or adapter harness.

Each pin connector **226** of the secondary harness connectors **206** is electrically connected to the control circuit **300** via one of the interconnects **218**. As shown in FIG. **3**, at least one pin connector **226** from each secondary harness connector **206** is electrically connected in parallel with one of the pin connectors **226** from each of the other secondary harness connectors **206**. In the illustrated embodiment, each pin connector **226** from the second secondary harness connector **232** is electrically connected in parallel with one pin connector **226** from the first secondary harness connector **230**.

Similar to the main harness connectors **204**, pin connectors **226** from different secondary harness connectors **206** that are connected in parallel with one another are also connected to a common I/O pin **304** on the control circuit **300**. Additionally, one or more of the pin connectors **226** from each of the secondary harness connectors **206** may be remapped by modifying the I/O pin configuration of the control circuit **300** in the same manner described above.

The illustrated controller **200** also includes a plurality of separate secondary component connectors **234**, each of which is connected in parallel with one of the pin connectors **226** from at least one of the secondary harness connectors **206**. The secondary component connectors **234** are configured to provide an electrical connection between the control circuit **300** and at least one of an ignition device and an inducer blower via non-harnessed cables or wires. In the illustrated embodiment, the secondary component connectors **234** are spade-type connectors, although the secondary component connectors **234** may include any suitable connector that enables the controller **200** to function as described herein including, for example and without limitation, screw-type connectors.

The circulator output connector **212** and the circulator return connector **214** are configured to provide an electrical connection between the air circulator **106** and the control circuit **300**. The circulator output connector **212** and the circulator return connector **214** are each connected to the control circuit **300** via conductive interconnects **218**. The circulator output connector **212** and the circulator return connector **214** may include any suitable connector that enables the controller **200** to function as described herein including, for example and without limitation, spade-type connectors and screw-type connectors.

The controller **200** is configured to energize the air circulator **106** by supplying a control voltage to the air circulator **106** via the circulator output connector **212** and the circulator return connector **214**. As described in more detail herein, the controller **200** may be configured to output one of a plurality of circulator control voltages based on a user selection. The controller **200** may also be configured to output a control voltage to the air circulator **106** based upon an operating mode of the furnace system **100**. For example, in one embodiment, the controller **200** may be configured to output a first control voltage that corresponds to a first, low fan speed, and a second control voltage that corresponds to a second, higher fan speed.

The user interface **208** is connected to the circuit board **202**, and is electrically connected to the computing device **302** via interconnects **218**. In the illustrated embodiment, the user interface **208** is electrically connected to the computing device **302** through the control circuit **300**. The user interface **208** includes a display device **236** and an input interface **238**. The user interface **208** is configured to present user configurable settings of the controller **200** to a user with the display device **236**, and receive and store user selections associated with the user configurable settings with the input interface **238**.

In the illustrated embodiment, the display device **236** includes a seven-segment liquid crystal display (LCD), although the display device **236** may include any suitable display device that enables the controller **200** to function as described herein, such as, for example, a cathode ray tube (CRT), a liquid crystal display (LCD), an organic LED (OLED) display, an LED matrix display, and/or an "electronic ink" display. Further, the display device **236** may include more than one display device. In the illustrated embodiment, the display device is configured to display user-configurable settings and a plurality of options corresponding to each user-configurable setting. In another suitable embodiment, the display device **236** includes a plurality individual light indicators (e.g., LEDs) each corresponding to one of the user-configurable settings and/or the plurality of options corresponding to the user-configurable setting.

The input interface **238** is configured to receive input from a user. In the illustrated embodiment, the input interface **238** includes a plurality of push buttons **240**, **242**, **244** to receive input from a user. The push buttons **240** and **244** allow a user to cycle through user-configurable settings and user-selectable options corresponding to the user-configurable setting. The push button **242** allows a user to select a user-configurable setting and a user-selectable option corresponding to a user-configurable setting. In other embodiments, the input interface **238** may include any suitable input device that enables the controller **200** to function as described herein, such as, for example, a keyboard, a pointing device, a mouse, a stylus, a touch sensitive panel (e.g., a touch pad or a touch screen), a gyroscope, an accelerometer, a position detector, and/or an audio user input interface. A single component, such as a touch screen, may function as both the display device **236** and the input interface **238**.

FIG. **4** is a block diagram of the computing device **302** and the user interface **208**. The computing device **302** includes at least one computer-readable storage device **402** and a processor **404** that is coupled to the storage device **402** for executing instructions. In this embodiment, executable instructions are stored in the storage device **402**, and the computing device **302** performs one or more operations described herein by programming the processor **404**. For example, the processor **404** may be programmed by encoding an operation as one or more executable instructions and by providing the executable instructions in the storage device **402**.

The processor **404** may include one or more processing units (e.g., in a multi-core configuration). Further, the processor **404** may be implemented using one or more heterogeneous processor systems in which a main processor is present with secondary processors on a single chip. As another illustrative example, the processor **404** may be a symmetric multi-processor system containing multiple processors of the same type. Further, the processor **404** may be implemented using any suitable programmable circuit including one or more systems and microcontrollers, microprocessors, programmable logic controllers (PLCs), reduced instruction set circuits (RISC), application specific integrated circuits (ASIC), programmable logic circuits, field programmable gate arrays (FPGA), and any other circuit capable of executing the functions described herein. Further, the processor **404** may include an internal clock to monitor the timing of certain events.

The storage device **402** is one or more devices that enable information such as executable instructions and/or other data to be stored and retrieved. The storage device **402** may include one or more computer readable media, such as, without limitation, dynamic random access memory (DRAM), static random access memory (SRAM), a solid state disk, and/or a hard disk. The storage device **402** may be configured to store, without limitation, application source code, application object code, source code portions of interest, object code portions of interest, configuration data, execution events and/or any other type of data.

As noted above, the user interface **208** includes a display device (broadly, a presentation interface) **236** and an input interface **238**. The display device **236** is coupled to the processor **404**, and presents information, such as user-configurable settings, to a user **406**, such as a technician. The input interface **238** is coupled to the processor **404** and is configured to receive input from the user **406**.

The computing device **302** further includes a communication interface **408** coupled to processor **404**. The communication interface **408** is coupled to the I/O pins **304**, and enables the processor **404** to communicate with one or more components of the furnace system **100**.

As noted above, the controller **200** of the present disclosure is configured to receive and store user selections corresponding to a plurality of user-configurable settings. User-configurable settings include, but are not limited to, an ignition device voltage, a circulator voltage, and an I/O pin configuration.

The ignition device voltage setting enables a user to select between one of a plurality of ignition device voltages to be supplied to the ignition device **112** by the controller **200**. The controller **200** is configured to output one of the plurality of ignition device voltages to the ignition device **112** based on a user selected ignition device voltage. In other words, the controller **200** is selectively configurable between a plurality of ignition device voltages. In one suitable embodiment, the plurality of ignition device voltages includes a first ignition device voltage and a second ignition device voltage that is less than the first ignition device voltage. In one particular embodiment, the first ignition device voltage is 80 VAC and the second ignition device voltage is 120 VAC. That is, when the first ignition device voltage is selected, the controller **200** is configured to output 80 VAC to the ignition device **112**, and when the second ignition device voltage is selected, the controller **200** is configured to output 120 VAC to the ignition device **112**.

The circulator voltage setting enables a user to select between one of a plurality of circulator control voltages to be supplied to the air circulator **106** by the controller **200**. The controller **200** is configured to output one of the plurality of circulator control voltages to the air circulator **106** based on a user selected circulator voltage. In other words, the controller **200** is selectively configurable between a plurality of circulator control voltages. In one suitable embodiment, the plurality of circulator control voltages includes a first circulator control voltage and a second circulator control voltage that is greater than the first circulator control voltage. In one particular embodiment, the first circulator control voltage corresponds to a voltage requirement of permanent split capacitor (PSC) type air circulators, and the second circulator control voltage corresponds to a voltage requirement of electrically commutated motor (EMC) type air circulators. In such embodiments, the first circulator control voltage may be 120 VAC, and the second circulator control voltage may be at least one of 24 VAC, 24 VDC, and a modulated 24 VDC signal (such as a pulse-width modulated signal). That is, when the first circulator control voltage is selected, the controller **200** is configured to output 120 VAC to the air circulator **106**, and when the second circulator control voltage is selected, the controller **200** is configured to output at least one of 24 VAC, 24 VDC, and a modulated 24 VDC signal to the air circulator **106**.

The I/O pin configuration setting enables a user to select one of a plurality of I/O pin configurations of the control circuit **300**, where the control circuit **300** processes signals differently or outputs signals differently from the same I/O pin in different I/O pin configurations. Because each of the pin connectors **226** is connected to one of the I/O pins **304**, the I/O pin configuration setting enables a user to remap the pin connectors **226** of one or more of the main harness connectors **204** and the secondary harness connectors **206**. Thus, the I/O pin configuration setting may also be referred to as a harness connector pin configuration setting because it enables a user to select one of a plurality of harness connector pin configurations.

In some embodiments, each of the I/O pin configurations (and, more particularly, the corresponding pin configurations of the main harness connectors **204** and secondary harness connectors **206**) may correspond to one of a plurality of furnace system manufacturers' standard wiring harness configurations. Examples of furnace system manufacturers to which the I/O pin configurations may correspond include, but are not limited to, Carrier Corporation of Farmington, Conn., Goodman Manufacturing Company, L.P., of Houston, Tex., Lennox International Inc. of Richardson, Tex., Trane, a subsidiary of Ingersoll Rand of Dublin, Ireland, Rheem Manufacturing Company of Atlanta, Ga., York, a subsidiary of Johnson Controls, Inc. of Milwaukee, Wis., and Nordyne LLC of O'Fallon, Mo.

The controller **200**, and, more specifically, the user interface **208**, is configured to display the user configurable settings, and receive a user selection of one of the user configurable settings. For each user-configurable setting, the controller **200**, and, more specifically, the user interface **208**, is configured to display a plurality of user-selectable options corresponding to one of the user-configurable settings, and receive a user-selection of one of the plurality of options.

As noted above, the controller **200** of the present disclosure can be installed in furnace systems manufactured by different furnace system manufactures without using interface or adapter harnesses (broadly, interconnecting harnesses). In particular, the controller **200** includes multiple main harness connectors **204** and multiple secondary harness connectors **206** mounted on a single board, where each harness connector has a different pin configuration. Further, the controller **200** enables one or more of the pin connectors **226** of the main harness connectors **204** and the secondary harness connectors **206** to be remapped so that the pin configurations of the harness connectors can be modified to match the wiring harness of a particular furnace system. As a result, a user, such as a technician, may install the controller **200** in a variety of different furnace systems manufactured by different furnace system manufacturers without using an adapter or interface harness.

To install the controller **200** in a furnace system, such as the furnace system **100** shown in FIG. **1**, one of the main harness connectors **204** is connected to the main wiring harness of the furnace system to provide an electrical connection between the control circuit **300** and components of the furnace system. Only one of the main harness connectors **204** is configured to be electrically connected to a furnace system at a time. Thus, only one of the main harness connectors **204** is connected to the main wiring harness of the furnace system. The main harness connector **204** may be directly connected to the main wiring harness of the furnace system (i.e., without any interconnecting harnesses or devices). In the illustrated embodiment, each of the main harness connectors **204** provides an electrical connection between the control circuit **300** and the pressure sensor **130**, the temperature sensor **132**, and the main burner valve **116**. Further, in the illustrated embodiment, the second main harness connector **222** and the third main harness connector **224** are configured to provide an electrical connection between the control circuit **300** and the flame rollout detector **134** and the flame sensor **136**.

One of the secondary harness connectors **206** is connected to a secondary wiring harness of the furnace system to provide an electrical connection between the control circuit **300** and other components of the furnace system that are not electrically connected to the control circuit via one of the main harness connectors **204**. In particular, each secondary harness connector **206** is configured to provide an electrical connection between the control circuit **300** and at least one of an ignition device and an inducer blower of the furnace system. Only one of the secondary harness connectors **206** is configured to be electrically connected to a furnace system at a time. Thus, only one of the secondary harness connectors **206** is connected to the secondary wiring harness of the furnace system. The secondary harness connector **206** may be directly connected to the secondary wiring harness of the furnace system (i.e., without any interconnecting harnesses or devices).

The user configurable settings of the controller **200** may be configured using the user interface **208**. For example, one of the plurality of I/O pin configurations may be selected using the user interface **208** based upon the configuration of the main wiring harness and/or the secondary wiring harness of the furnace system in which the controller **200** is installed. Further, one of the plurality of ignition device voltages may be selected using the user interface **208** based upon the type of ignition device installed in the furnace system. Similarly, one of the plurality of circulator control voltages may be selected using the user interface **208** based upon the type of circulator installed in the furnace system.

In some embodiments, the controller **200** is mounted to the furnace system **100** to provide a fixed support for the controller **200**. The controller **200** may be mounted to the furnace system **100** at any suitable location. In one suitable embodiment, the controller **200** is mounted to the furnace system **100** using suitable fasteners, such as screws or bolts. The controller **200** may be mounted to the furnace system **100** before, during, or after any of the above-described steps.

Embodiments of the methods and systems described herein achieve superior results as compared to prior methods and systems. For example, the furnace controllers described herein facilitate reducing the overall part-count and cost associated with furnace controllers, and provide increased compatibility as compared to known furnace controllers. In particular, the furnace controllers described herein provide multiple main harness connectors and multiple secondary harness connectors on a single control board, and enable pin connectors of the harness connectors to be remapped by modifying the I/O pin configuration of the control circuit. By providing multiple main harness connectors and multiple secondary harness connectors on the controller, and enabling the pin connectors of the harness connectors to be remapped, the furnace controllers of the present disclosure reduce or eliminate the need for interface or adapter harnesses commonly used to connect furnace controllers to furnace systems. As a result, the furnace controllers of the present disclosure have an overall reduced part-count and cost as compared to known furnace controllers, and facilitate installation by reducing the total number of connections needed to be made between the controller and a furnace system. Further, the furnace controllers described herein provide increased compatibility as compared to some known furnace controllers by enabling a user to select from a plurality of output voltages for certain components of furnace systems, such as the ignition device and the circulator.

Example embodiments of gas-powered furnace systems and furnace controllers are described above in detail. The system and controller are not limited to the specific embodiments described herein, but rather, components of the system and controller may be used independently and separately from other components described herein.

When introducing elements of the present disclosure or the embodiment(s) thereof, the articles “a”, “an”, “the” and “said” are intended to mean that there are one or more of the elements. The terms “comprising,” “including,” “containing” and “having” are intended to be inclusive and mean that there may be additional elements other than the listed elements. The use of terms indicating a particular orientation (e.g., “top”, “bottom”, “side”, etc.) is for convenience of description and does not require any particular orientation of the item described.

As various changes could be made in the above constructions and methods without departing from the scope of the disclosure, it is intended that all matter contained in the above description and shown in the accompanying drawing(s) shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A controller for use in a gas furnace system including a gas valve and an ignition device, the controller comprising:
- a circuit board;
- a control circuit connected to the circuit board and configured to control operation of the gas valve and the ignition device; and
- a plurality of harness connectors mounted to the circuit board, each harness connector configured to mate with a complementary wiring harness to electrically connect the control circuit to at least one component of the furnace system, each harness connector including a plurality of pin connectors defining a pin configuration of the corresponding harness connector, each pin configuration being different than the other pin configurations,
- wherein at least one pin connector from each harness connector is electrically connected in parallel with one of the pin connectors from each of the other harness connectors.

2. The furnace controller of claim **1**, wherein the control circuit includes a plurality of I/O pins for electrical communication with components of the furnace system, wherein a first pin connector from each harness connector is connected to a first I/O pin of the plurality of I/O pins, each first pin connector connected in parallel with each of the other first pin connectors.

3. The furnace controller of claim **2**, wherein the control circuit is configurable between a first I/O pin configuration and a second I/O pin configuration, wherein the first I/O pin is configured to output or receive a first signal in the first I/O pin configuration and a second signal in the second pin configuration that is different than the first signal.

4. The furnace controller of claim **3**, wherein each I/O pin configuration corresponds to one of a plurality of furnace system manufactures’ default wiring harness configurations.

5. The furnace controller of claim **1**, wherein the controller is configured to output one of a first ignition device voltage and a second ignition device voltage to the ignition device based upon a user selected ignition device voltage.

6. The furnace controller of claim **1**, wherein the furnace system further includes an air circulator, the controller further configured to output one of a first circulator control voltage and a second circulator control voltage to the air circulator based upon a user selected circulator voltage.

7. The furnace controller of claim **1**, wherein each of the harness connectors is a main harness connector, the controller further comprising a plurality of secondary harness connectors, each of the secondary harness connectors configured to mate with a wiring harness to electrically connect the control circuit to at least one of an ignition device and an inducer blower of the furnace system.

8. The furnace controller of claim **1**, wherein the furnace system further includes a flame sensor, wherein one of the pin connectors of at least one of the harness connectors is configured to receive an input signal from the flame sensor, the control board further comprising a flame sensor input connector separate from each of the harness connectors, the flame sensor input connector connected in parallel with each of the pin connectors configured to receive an input signal from the flame sensor.

9. A furnace system comprising:
- a burner;
- a gas valve for controlling the supply of gas to the burner;
- an ignition device for igniting gas supplied to the burner; and
- a controller comprising:
  - a circuit board;
  - a control circuit connected to the circuit board and configured to control operation of the gas valve and the ignition device; and
  - a plurality of harness connectors mounted to the circuit board, each harness connector including a plurality of pin connectors, at least one pin connector from each harness connector electrically connected in parallel with one of the pin connectors from each of the other harness connectors, wherein only one of the harness connectors is connected to the furnace system by a wiring harness, the wiring harness being complementary to the one harness connector.

10. The furnace system of claim **9**, wherein the control circuit includes a plurality of I/O pins for electrical communication with components of the furnace system, wherein a first pin connector from each harness connector is connected to a first I/O pin of the plurality of I/O pins, each first pin connector connected in parallel with each of the other first pin connectors.

11. The furnace system of claim **10**, wherein the control circuit is configurable between a first I/O pin configuration and a second I/O pin configuration, wherein the first I/O pin is configured to output or receive a first signal in the first I/O pin configuration and a second signal in the second pin configuration that is different than the first signal.

12. The furnace system of claim **11**, wherein each I/O pin configuration corresponds to one of a plurality of furnace system manufactures’ default wiring harness configurations.

13. The furnace system of claim **9**, wherein each of the harness connectors has a pin configuration defined by the plurality of pin connectors corresponding to the harness connector, wherein each pin configuration is different than the other pin configurations and at least one of the harness connectors has a different number of pin connectors than the other harness connectors.

14. The furnace system of claim **9**, wherein the controller is configured to output one of a first ignition device voltage and a second ignition device voltage to the ignition device based upon a user selected ignition device voltage.

15. The furnace system of claim **9**, further comprising an air circulator, the controller further configured to output one of a first circulator control voltage and a second circulator control voltage to the air circulator based upon a user selected circulator voltage.

16. The furnace system of claim **9**, wherein each of the harness connectors is a main harness connector, the controller further comprising a plurality of secondary harness connectors, wherein only one of the secondary harness connectors is connected to the furnace system by a wiring harness to provide an electrical connection between the control circuit and the ignition device.

17. A method of installing a furnace controller in a furnace system including a gas valve, an ignition device, and a wiring harness, the furnace controller including a circuit board, a control circuit configured to control operation of the gas valve and the ignition device, and a plurality of harness connectors mounted to the circuit board, each harness connector including a plurality of pin connectors, wherein at least one pin connector from each harness connector is electrically connected in parallel with one of the pin connectors from each of the other harness connectors, the method comprising:

mounting the controller to the furnace system;

selecting one of the harness connectors for connection to the wiring harness of the furnace system based on a pin configuration of the wiring harness, the one harness connector having a pin configuration complementary to the pin configuration of the wiring harness; and

connecting only the selected harness connector to the wiring harness to electrically connect the control circuit to at least one component of the furnace system.

18. The method of claim **17**, wherein connecting only one of the harness connectors includes connecting the one harness connector directly to the wiring harness of the furnace system without any interconnecting harnesses.

19. The method of claim **17**, wherein the furnace controller includes a user interface, the method further comprising selecting one of a plurality of I/O pin configurations using the user interface, wherein at least one of the I/O pin configurations corresponds to one of a plurality of furnace system manufactures' default wiring harness configurations.

20. The method of claim **17**, wherein each of the harness connectors is a main harness connector and the wiring harness of the furnace system is a main wiring harness, the furnace system further including a secondary wiring harness and the controller further including a plurality of secondary harness connectors, the method further comprising:

connecting only one of the secondary harness connectors to the secondary wiring harness to electrically connect the control circuit to the ignition device.

21. The method of claim **20**, wherein the furnace controller further includes a user interface, the method further comprising selecting, using the user interface, one of a plurality of ignition device voltages to be supplied to the ignition device by the controller.

22. The method of claim **17**, wherein the furnace system further includes an air circulator, the method further comprising:

electrically connecting the air circulator to the controller; and

selecting, using the user interface, one of a plurality of circulator control voltages to be output to the circulator by the controller.

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